INSTRUCTION MANUAL

i-Meter   SKYRC

Multimeter 7 in 1

TABLE OF CONTENTS

⚠ CAUTION - Before you start

This is a sophisticated unit which will be an important tool in your electric powered model program. Please be careful with it! And please read this instruction manual thoroughly before operating.

Do not disassemble, modify or subject the unit to force impact.

Keep the i-Meter well away from dirt or water.

High power electrical systems pose dangers independent of devices like the i-Meter and it is the user's responsibility to be familiar with these dangers and take any necessary action to ensure safe use. Shorting a rechargeable battery or a i-Meter connected to a rechargeable battery or battery charger can supply huge currents and have serious consequences including explosions, causing fire, damage to equipment and personal injury.

There are risks associated with the potentially high currents measured by the i-Meter. These include, but are not limited to, fire, burns and personal injury. The user must be familiar with the relevant methods, procedures and connection components before using or making any connection.

Do not exceed a maximum of 60 volts for the main power pack (MPP)

Keep proper distance from propeller during measurement process.

SKYRC

INTRODUCTION

Thank you for the purchase of this SKYRC i-Meter. The SkyRC i-Meter can carry out an enormous range of functions related to Electric Powered models and has been designed with ease of use as a prime objective. This Instruction Manual describes the scope of i-Meter and how to make it work for you.

Input

Voltage Port

LCD Display
Dot Matrix 128*64

Connector to Temperature Sensor Probe

Connector to Servo

Potentiometer Dial to Control Servos, ESC, other PW devices

Enter

Back ESC

Mode

Output

Optical Tachometer Sensor

FEATURES

1. Battery Checker
2. Battery Internal Resistance
3. Watt Meter
4. Servo Tester
5. Optical Tachometer
6. Temperature Gauge
7. Thrust Calculator

SET CONTENTS
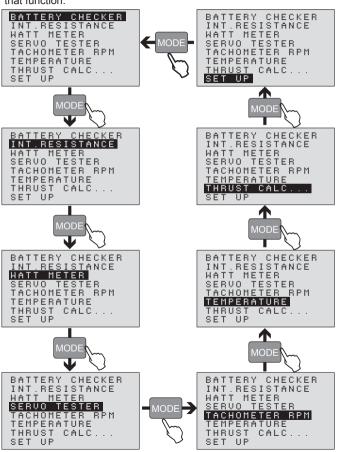

1. Input Cable
2. Battery Internal Resistance Cable
3. i-Meter
4. Temperature Probe
5. Output Cable

The Main screen displays all the available functions. The desired function can be accessed by highlighting the desired function by pressing 'MODE' button, pressing the 'ENTER' button to select that function.

```
BATTERY CHECKER          BATTERY CHECKER
INT.RESISTANCE           INT.RESISTANCE
WATT METER               WATT METER
SERVO TESTER     ← MODE  SERVO TESTER
TACHOMETER RPM           TACHOMETER RPM
TEMPERATURE              TEMPERATURE
THRUST CALC...           THRUST CALC...
SET UP                   SET UP
```

MODE   MODE

```
BATTERY CHECKER          BATTERY CHECKER
INT.RESISTANCE           INT.RESISTANCE
WATT METER               WATT METER
SERVO TESTER             SERVO TESTER
TACHOMETER RPM           TACHOMETER RPM
TEMPERATURE              TEMPERATURE
THRUST CALC...           THRUST CALC...
SET UP                   SET UP
```

MODE   MODE

```
BATTERY CHECKER          BATTERY CHECKER
INT.RESISTANCE           INT.RESISTANCE
WATT METER               WATT METER
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TEMPERATURE              TEMPERATURE
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SET UP                   SET UP
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MODE   MODE

```
BATTERY CHECKER          BATTERY CHECKER
INT.RESISTANCE           INT.RESISTANCE
WATT METER               WATT METER
SERVO TESTER     MODE →  SERVO TESTER
TACHOMETER RPM           TACHOMETER RPM
TEMPERATURE              TEMPERATURE
THRUST CALC...           THRUST CALC...
SET UP                   SET UP
```

BATTERY CHECKER

The i-Meter allows you to check the individual cell voltages of a 2 cells-8 cells Lithium battery. The i-Meter individually measures & diagnoses the cell voltages of the multiple cells, the result is displayed on the large liquid crystal screen. The i-Meter replaces all of the tedious measurement and calculations required in the past to determine the overall voltage of the LiPo, LiFe & LiIon pack and the individual cell voltages that determine the balance of the Lithium pack.

The i-Meter now makes it possible to determine and verify the detailed state of the Lithium battery.

A balanced battery provides a safer environment when flying. If you know that your cell balance is out you can address the issue.
The prevention of deteriorating cells over time, will improve the efficiency and stability of the Lithium battery.

When you connect the balance lead to the i-Meter you must ensure that both the Ground pin's for the balance connector and the i-Meter go together. Different Balance leads have different wiring configurations and some are colored.
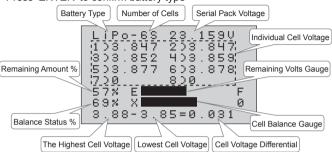
The i-Meter has 2.54mm pin intervals. If the connector on you battery does not fit do not force the connector, obtain a suitable adaptor lead from your hobby shop.

Battery Connection Diagram

- Connect the balance lead to 'VOLT PORT'
- Press 'ENTER' to enter main function screen
- Press 'ENTER' to select BATTERY CHECKER function
- Press 'MODE' to select battery type
- Press 'ENTER' to confirm battery type

| Battery Type | Number of Cells | Serial Pack Voltage |

```
LiPo-6S 23.159V
1)3.847  2)3.847
3)3.852  4)3.859
5)3.877  6)3.878
7)0      8)0
57% E            F
69% X            0
3.88-3.85=0.031
```

Individual Cell Voltage

Remaining Amount %

Remaining Volts Gauge

Balance Status %

Cell Balance Gauge

The Highest Cell Voltage | Lowest Cell Voltage | Cell Voltage Differential

Serial voltage
Pack voltage of the whole battery (total voltage of all cells) is indicated

The number of serial cells
The total number of cells in the battery pack is indicated (6S as indicated in the picture 6 serial cells). This is the same as the cell quantity.

Remaining amount fuel gauge
The remaining amount gauge gives you a graphical bar graph display of the status of the battery by graph and the balance of the cells by graph. When the battery is fully charged the graph extends to "F" on the right hand side of the LCD. As in the example you can see that the battery is about 50% used. There are times when differences occur between the remaining amount and the actual remaining amount. These differences can be associated with the quality and use of the battery and its cells. A battery that has always been charged with a reputable balancer is likely to reproduce accurate readings on the i-Meter. A battery that has had a hard life full discharge and recharge with no balance charging is more likely to have discrepancies between actual and shown results.

Cell balance gauge
The Cell balance gauge measures the difference between all cells that are connected to the i-Meter.

The difference is shown graphically between the cell that is showing the highest cell voltage to the cell that is showing the lowest cell voltage (largest cell voltage difference) indicated on the graph. When the cell voltages read equal, the bar extends all the way to the right (O). This indicates that the cells are all balanced to a satisfactory level. When the cells have a difference in voltage the bar shortens and indicates towards the left (X). In order to maintain long lasting battery life if the balance gauge does not show a satisfactory cell balance then a cell balancer should be applied to the pack before use. If the cell balance indication is low after the battery has been used this can be normal and charging should occur with a balance charger.

BATTERY INTERNAL RESISTANCE

The i-Meter has been created to give you the ability to make an informed determination of what the true cell and pack ratings by providing a useful measure, the cell internal resistance.

- Connect battery to i-Meter via Voltage Port to power on the i-Meter
- Using supplied cable (pitch 2.54mm) to measure individual internal resistance
- Press 'MODE' to select 'INT. RESISTANCE' function
- Press 'ENTER' to confirm selection

Connection Diagram for Measurement of Battery Internal Resistance

Once we have an idea of the internal resistance of a cell we can then use that to determine how efficient our power setup is as well as knowing how much power is being turned to heat in the battery pack and additionally know how much the voltage can potentially drop under load.

```
BATTERY CHECKER
INT.RESISTANCE
WATT METER
SERVO TESTER
TACHOMETER RPM
TEMPERATURE
THRUST CALC...
SET UP
```

```
Int.Resietance

  Res:  39 mohm
```

Let it be stated that there is no perfect test for cell internal resistance. Due to the nature of batteries, cells exhibit characteristics of resistance, capacitance and inductance of which all contribute to the measured internal resistance. Internal resistance can vary considerably even within the same cell, this makes the task of determining the internal resistance a lot harder.

Factors effecting resistance readings:
Contact corrosion
While not actually part of the cell itself, having dirty contacts to the cells can make a noticeable difference in the resistance. Wiping clean the contacts can improve contact resistance by 10 or more milliohms.

Cell temperature
For many cell chemistries the resistance of the pack decreases initially from room temperature to a certain level (perhaps 45C) after which the resistance of the pack will increase again. Lithium cells in particular suffer poor cell resistance near 0C.

Cell charge
Generally the closer to a full charge a cell is the lower the internal resistance.
Cell age
As cells become older their internal resistance tends to increase.

The i-Meter has been built to allow cells to be tested under a known set of loads which will facilitate comparisons.

PRECAUTIONS

1. Do not leave a cell connected to the i-Meter for more than five minutes.
2. Be aware that although the i-Meter only takes small samples from the battery pack, the voltage will be reduced. Make sure you check your pack balance.
3. Avoid plugging the cell in reverse polarity. The i-Meter can cope with a reversed connection for a few seconds but it's still better not to do it in the first place.
4. Do not connect more than 5V to the cell inputs, again, the IRM can cope for a few seconds but it's best not to do it!

WATT METER

This function measures Current (Amps), Peak current, Voltage (Volts), Power (Watts), Energy(Watt-Hours) and Charge(Amp-Hours) values for you, in real-time, for the circuit in which you connect it.

i-Meter is activated when the battery is connected to the unit.

● Press 'MODE' to select 'WATT METER' function
● Press 'ENTER' to confirm selection

Now you can stop wondering what's going on with your electric model and get answers that allow you to apply science to your hobby. The precise measurements you collect will help you fine tune your model to get all the performance that you paid for.

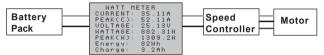With watt meter function, it is now easy to determine things like:

● Flight time
● Current through an ESC and motor
● ESC, BEC and motor efficiencies
● Charge put into and removed from a battery and the performance of battery chargers
● Battery health
● Why power is lost during acrobatics or extreme conditions

- Effect of gearing and propeller size and shape on power consumption and battery currents
- Effects of modifications, age and damage on many electrical system components
- Clever hobbyists will discover new applications to further improve electric model performance.

The following are some examples of meter connections. Many other arrangements and uses are possible

Testing Loads (e.g. motors)

```
              WATT METER
              CURRENT:  35.11A
Battery       PEAK(C):  52.11A        Speed
Pack          VOLTAGE:  25.13V        Controller      Motor
              WATTAGE: 882.31W
              PEAK(W): 1309.2W
              Energy:   82Wh
              Charge:   3.2Ah
```

Battery on SOURCE side, Electronic Speed Controller (ESC) and motor on LOAD side, with ESC on, the meter shows the current into the motor, voltage and power at the battery and accumulates the charge (Ah) while the motor is running.

Battery Charging

```
              WATT METER
              CURRENT:  35.11A
Battery       PEAK(C):  52.11A
Charger       VOLTAGE:  25.13V        Battery
              WATTAGE: 882.31W
              PEAK(W): 1309.2W
              Energy:   82Wh
              Charge:   3.2Ah
```
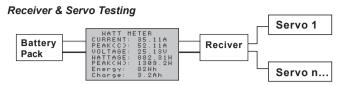
With a battery charger on the SOURCE side and battery pack on the LOAD side, the meter shows the charging current into the battery, the voltage and charging power at the battery and accumulates the charge (Ah) into the battery.

Battery Discharging

```
              WATT METER
              CURRENT:  35.11A
Battery       PEAK(C):  52.11A        Discharge
Pack          VOLTAGE:  25.13V        Load
              WATTAGE: 882.31W
              PEAK(W): 1309.2W
              Energy:   82Wh
              Charge:   3.2Ah
```

When the battery is discharged, the meter indicates the total charge (Ah) the battery delivered to the load as well as current, voltage and discharging power.

Receiver & Servo Testing


```
WATT METER
CURRENT: 35.11A
PEAK(C): 52.11A
VOLTAGE: 25.13V
WATTAGE: 882.31W
PEAK(W): 1309.2W
Energy: 82Wh
Charge: 3.2Ah
```

Battery Pack → Reciver → Servo 1 / Servo n...

SERVO TESTER

Servo testers are very useful for exercising your servos and Electronic Speed Control (ESC) without the need to turn on your transmitter, and you do not even need your receiver. The servo tester will put out a signal just like the signals normally sent by your receiver to the servos or ESC.   The dial knob on the servo tester will change the signal just like moving your transmitter stick would change the signal going to a servo or ESC.

To use the tester to evaluate a servo
Connecting a battery to the i-Meter volt port. Plug a servo into the servo port. The servo can be controlled with the adjustment dial under Manual Mode. Press 'MODE' button once to set the PPM signal to auto. The servo tester will use 1520us as centre and automatically output cycling signal to move the servo arm back and forward.
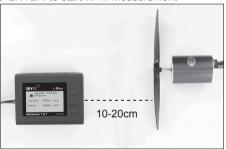
To use the Servo Tester to operate an ESC and motor
Connecting a battery to the i-Meter volt port. Another plug connected to the Servo Tester is the plug from the ESC that normally goes to the receiver. Connect the ESC to motor leads.   When you connect the battery to the ESC it will power up. It should react the same way does when powered up using the radio gear with the throttle stick in the minimum power position. You can now spin up the motor by turning the servo tester knob. No receiver or transmitter is needed. This is a great way to test motors on the bench.

TACHEOMETER RPM

There is an optical tachometer within i-Meter. An optical tacho sensor is fitted to the right side i-Meter case and is activated by pointing i-Meter towards the propeller at a distance of 10 and 20cm from the propeller.

- Connect battery to i-Meter via Voltage Port to power on the i-Meter
- Press 'MODE' to select "TACHOMETER RPM"
- Press 'ENTER' to confirm the function
- Press 'MODE' again to change the range of 1-5 blades
- Press 'ENTER' to start RPM measurement

10-20cm

The fluctuating light caused by the rotation of the propeller is sensed and counted over a period of either 1 or 2 seconds. Allow a couple of seconds for readings to steady.

With a geared motor, the motor RPM will normally be higher than the prop. RPM, but it is the prop rpm which is being measured and quoted, so the gear ratio is not really relevant.
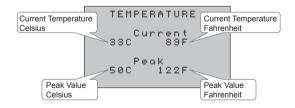
Please DON'T use optical tachometer with fluorescent lighting which will give false readings, such as 3000 or 3600 rpm.

The optical RPM sensor will function over a large range of propeller sizes, RPM and lighting conditions. It has even able to measure 40mm diameter model boat props spinning in the air. Experiment with different sensor positions. In some cases, best results may be achieved by testing in the shade. With the motor running, move the optical sensor to about 10~20 cm from the propellers, taking all due care. Small propellers may require closer positioning. The number of propeller blades should also be set. Wrong setting will affect RPM readings for the optical tachometer. For example, fitting a three bladed propellers, but leaving the i-Meter blade figure at 2 would cause the optical tachometer to read 50% high.

TEMPERATURE

There is a temperature sensor available, so you can monitor the temperature of battery, motor, electronic speed controller, etc. When no sensor is connected, display will indicate 0.0°C and 32°F

- Connect temperature probe to i-Meter
- Press 'MODE' to select "TEMPERATURE"
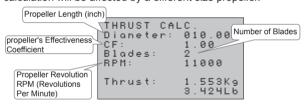- Press "ENTER" to confirm selection

Current Temperature Celsius	TEMPERATURE	Current Temperature Fahrenheit
	Current	
	33C 89F	
	Peak	
Peak Value Celsius	50C 122F	Peak Value Fahrenheit

THRUST CALCULATOR

The thrust calculator can estimate the thrust of an airplane, there are many variances and some known factors.

Lets assume we have an airplane and this is its first flight. We know the size of the propeller and we can do a static full throttle rpm check with a tachometer on the ground. We can now add these known figures into Thrust Calculator. By the fact that you can verify thrust it becomes possible, to estimate the general power of the airplane in advance. This will give you more knowledge about your plane and the power characteristics to make your first flight less challenging and safe, after all you may have other flight characteristics to deal with. This should help you to estimate flight take off distances, recovery from a stall. For more experienced pilots this will enable them to calculate if the plane is going to be able to hover. It can show you what changes to the power calculation will be affected by a different size propeller.

Propeller Length (inch)

propeller's Effectiveness Coefficient

Propeller Revolution RPM (Revolutions Per Minute)

```
THRUST CALC.
Diameter:  010.00
CF:         1.00
Blades:     2
RPM:        11000

Thrust:     1.553Kg
            3.424Lb
```

Number of Blades

CF (Propeller's Effectiveness Coefficient Table)

Manufacturer	CF
Standard propeller	1.00
APC propeller	1.06
APC SF	1.50
APC W propeller	1.09
MenzS propeller	1.03
Bambula propeller	1.02
Bolly clubman	1.04
Cox	1.10
GWS HD	0.75
GWS RS (SF)	1.10
Smart	1.02
Zinger Wood	1.00

The static thrust calculation is taken from the October 86 AMA magazine, air density is based on 29.92 in Hg, and propeller pitch is not used in this calculation. Practical tests revealed very little if any change in thrust due to pitch variation at the same RMP.

It is believed that this is partly due to any increase in thrust being negated by blade stalling and a more turbulent influx area with increased pitch. This obviously only applies to static conditions, not flying conditions.

PRODUCT SPECIFICATIONS

- Max input voltage: 60V
- Voltage measurement range: 2-8S LiPo/LiFe/LiIon
- Voltage display resolution: 0.001V
- Volt Port: 2.54mm pitch pins, 9 pins
- Max current: 100A
- Shunt resistance:0.001ohm
- Displayed resolution A: 0.01
- Temperature resolution: 1 Celsius / 1 Fahrenheit
- PPM signal output: 750uS – 2150uS
- Number of propeller measurable : 1 to 5
- Propeller rotating range: 1-60000RPM
- Dimension: 95.3x72.8x21.5mm
- Net Weight: 85g

WARRANTY AND SERVICE

We guarantee this product to be free of manufacturing and assembly defects for a period of one year from the time of purchase. The warranty only applies to material or operational defects, which are present at the time of purchase. During that period, we will repair or replace free of service charge for products deemed defective due to those causes.

You will be required to produce proof of purchase (invoice or receipt). This warranty is not valid for any damage or subsequent damage arising as a result of misuse, modification or as a result of failure to observe the procedures outlined in this manual.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Manufactured by
SKYRC TECHNOLOGY CO., LTD.
www.skyrc.com